CLAIMS

What is claimed is:

1. A CMP process control method, comprising the steps of:

providing a plurality of wafers having a set of pilot wafers and a set of remaining wafers;

polishing each of said pilot wafers according to an original process time;

determining a compensation time for said pilot wafers;

determining an update time by adding said compensation time to said original process time; and

polishing said set of remaining wafers according to said update time.

2. The method of claim 1 wherein said set of pilot wafers comprises at least two pilot wafers.

3. The method of claim 1 wherein said plurality of wafers comprises a wafer lot having from about 5 to about 50 wafers.

4. The method of claim 1 wherein said plurality of wafers comprises a wafer batch having from about 40 to about 500 wafers.

5. The method of claim 1 wherein each of said plurality of wafers comprises a shallow trench isolation structure including an oxide layer having a thickness of from about 2000 angstroms to about 15000 angstroms and a trench oxide depth of from about 1000 to about 1000 angstroms.

6. The method of claim 1 wherein said polishing each of said pilot wafers according to an original process time comprises or exclude oxide buff polishing of each of said pilot wafers.

7. The method of claim 1 wherein said determining a compensation time comprises the steps of:

measuring rates of material removal from said pilot wafers, respectively;

measuring divergences between a target thickness and post-polishing thicknesses of said pilot wafers, respectively;

calculating an average of said rates of material removal and calculating an average of said divergences;

calculating a quotient by dividing said average of said divergences by said average of said rates of material removal; and

multiplying said quotient by a compensation correction factor.

8. The method of claim 1 wherein said polishing each of said pilot wafers according to an original process time comprises polishing said pilot wafers at first, second, third and fourth polishing heads, respectively, of a CMP apparatus, and wherein said determining a compensation time comprises determining a compensation time for each of said polishing heads by:

measuring a rate of material removal from said pilot wafers at said first, second, third and fourth polishing heads, respectively;

measuring a divergence between a target thickness and a post-polishing thickness of said pilot wafers at said first, second, third and fourth polishing heads, respectively;

calculating a quotient for each of said polishing heads by dividing said divergence by said rate of material removal at each of said polishing heads; and

multiplying said quotient by a compensation correction factor.

9. A CMP process control method for a CMP apparatus having a plurality of polishing heads and a closed-loop controller, comprising the steps of:

providing a plurality of wafers having a set of pilot wafers and a set of remaining wafers;

polishing said pilot wafers on said polishing heads, respectively, according to an original process time;

determining a compensation time for said pilot wafers;

determining an update time by adding said compensation time to said original process time; and

polishing said set of remaining wafers by causing said controller to actuate said polishing heads according to said update time.

10. The method of claim 9 wherein said set of pilot wafers comprises at least two pilot wafers.

11. The method of claim 9 wherein said plurality of wafers comprises a wafer lot having from about 5 to about 50 wafers.

12. The method of claim 9 wherein said plurality of wafers comprises a wafer batch having from about 40 to about 500 wafers.

13. The method of claim 9 wherein each of said plurality of wafers comprises a shallow trench isolation structure including an oxide layer having a thickness of from about 2000 angstroms to about 15000 angstroms and a trench oxide depth of from about 1000 to about 10000 angstroms.

14. The method of claim 9 wherein said polishing each of said pilot wafers according to an original process time comprises oxide buff polishing of each of said pilot wafers.

15. The method of claim 9 wherein said determining a compensation time comprises the steps of:

measuring rates of material removal from said pilot wafers, respectively;

measuring divergences between a target thickness and post-polishing thicknesses of said pilot wafers, respectively;

calculating an average of said rates of material removal and calculating an average of said divergences;

calculating a quotient by dividing said average of said divergences by said average of said rates of material removal; and

multiplying said quotient by a compensation correction factor.

16. The method of claim 9 wherein said polishing each of said pilot wafers according to an original process time comprises polishing said pilot wafers at first, second, third and fourth polishing heads, respectively, of a CMP apparatus, and wherein said determining a compensation time comprises the steps of:

measuring a rate of material removal from said pilot wafers at said first, second, third and fourth polishing heads, respectively;

measuring a divergence between a target thickness and a post-CMP thickness of said pilot wafers at said first, second, third and fourth polishing heads, respectively;

calculating a quotient for each of said polishing heads by dividing said divergence by said rate of material removal at each of said polishing heads; and

multiplying said quotient by a compensation correction factor.

17. A CMP process control method for a metal CMP process, comprising the steps of:

providing a plurality of wafers having a set of pilot wafers and a set of remaining wafers, each of said plurality of wafers having a substrate and a metal layer provided on said substrate;

polishing said metal layer on each of said pilot wafers according to an original process time;

determining a compensation time for said pilot wafers;

determining an update time by adding said compensation time to said original process time; and

polishing said metal layer on said set of remaining wafers according to said update time.

18. The method of claim 17 wherein said determining a compensation time comprises the steps of:

measuring rates of material removal from said metal layer on said pilot wafers, respectively;

measuring divergences between a target thickness and post-polishing thicknesses of said pilot wafers, respectively;

calculating an average of said rates of material removal and calculating an average of said divergences;

calculating a quotient by dividing said average of said divergences by said average of said rates of material removal; and

multiplying said quotient by a compensation correction factor.

19. The method of claim 17 wherein said polishing said metal layer on each of said pilot wafers according to an original process time comprises polishing said metal layer on each of said pilot wafers at first, second, third and fourth polishing heads, respectively, of a CMP apparatus, and wherein said determining a compensation time comprises determining a compensation time for each of said polishing heads by:

measuring a rate of material removal from said metal layer on said pilot wafers at said first, second, third and fourth polishing heads, respectively;

measuring a divergence between a target thickness and a post-polishing thickness of pilot wafers at said first, second, third and fourth polishing heads, respectively;

calculating a quotient for said polishing heads by dividing said divergence by said rate of material removal at each of said polishing heads; and

multiplying said quotient by a compensation correction factor.

20. The method of claim 17 further comprising a dual damascene structure provided in said metal layer, said dual damascene structure having a trench depth of from about 1000 angstroms to about 3 um a low-k dielectric layer provided adjacent to said metal layer; a barrier layer provided in said trench; and a seed layer provided on said barrier layer.

21. The method of claim 20 wherein said metal layer is a metal selected from the group consisting of tungsten, copper, aluminum and alloys of tungsten, copper and aluminum.

22. The method of claim 20 wherein said barrier layer is a material selected from the group consisting of Ta, TaN and Tin.

23. The method of claim 20 wherein said low-k layer is a dielectric selected from the group consisting of FSG, BD, SiLK and HSQ.